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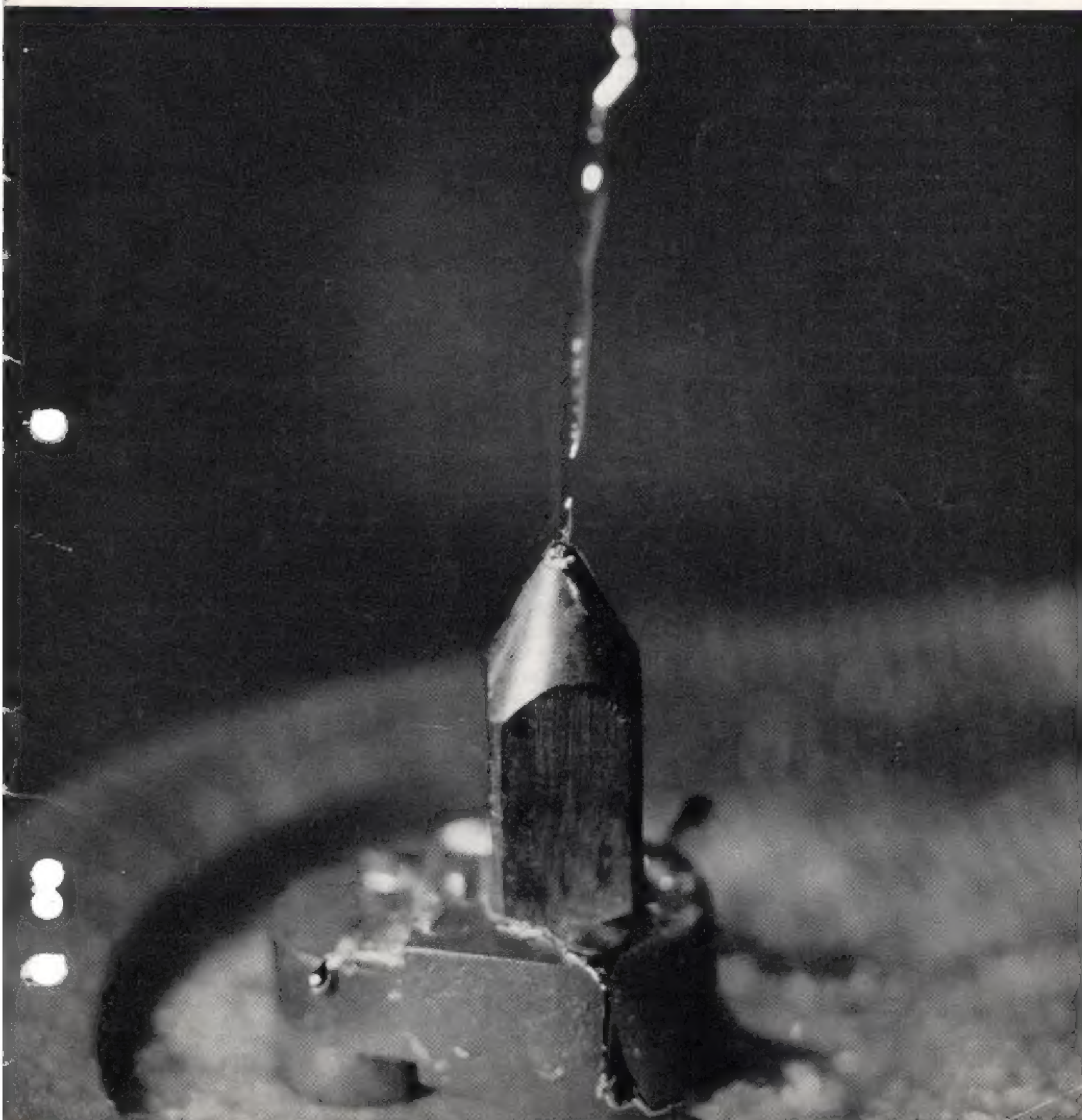


The Pump

The first part of this article appeared in Technical Bulletin No. 55.

To ensure that the pump rises truly vertically, it is lifted at three points, one at each side at the piston end, and one at the nozzle end, as follows:
The crosshead 19H1, being secured to the piston operating rod 19H, raises this and the upper crosshead a19H3 and thus, through the springs b20H and 20H11 (which will be considered later), the eye a20H2. The right-hand end of the piston lever c18H consequently rises, freeing one end of the pump body rod operating lever 29H of which the other end descends under the influence of spring a27H acting through the pump body operating rod and its extension a28H2. Two nuts 28H4 (middle and bottom), and a shoulder on this, form abutments engaging the end of the pivoted lifting levers d25H and b26H which are consequently depressed; their other extremities raise the pump at the piston-end (both sides) and at the nozzle end.

Simultaneously, the bearing block c24H1 rises with the pump. This movement is obtained by the crosshead 19H1 compressing the pump body spring a31H against the sleeve a31H11 and so raising another crosshead 31H2 carrying the eye a31H3. To this is attached the pump body lever c24H.

Upward travel of the crosshead 31H2 is limited by the nut 31H13 meeting the swing frame post casting d38H. This provides the right-hand end of lever c24H with an anchorage against any further upward movement, but it has already travelled sufficiently to seat the nozzle in the base of the mould.

Compression of the spring a31H absorbs further lift from the right-hand end of the crosshead 19H1, which continues to rise with the rod 19H still exerting lift (as before) on the right-hand end of lever c18H. But, since lever c24H is no longer free to rise bodily, the link a32H, about which both levers are free to pivot, causes their left-hand ends to be drawn together. The upper lever starts to exert downward pressure on the piston end of the pump. This latter force, however, is transmitted through the pump body to the upper jaw of lever d25H, to depress its right-hand end, and so, through nut 28H4 (bottom), the right-hand end of lever b26H. This results in lift at its left-hand end, so that contact between the nozzle and the mould is firmly held, the complete pump remaining level and tending to rise vertically, without tilt.

As an immediate result, there is stabilization of lever c24H, and link a32H, but, as the eye a20H2 continues to ascend, the left-hand end of lever c18H is depressed, forcing the piston down and so driving metal through the nozzle to the mould. It will be observed that any resistance occasioned to the piston's descent is resolved into a lifting tendency of link a32H, which results in an increase of pressure between the nozzle and the mould. This compensatory reaction is an important feature of the design, as it avoids unnecessary pressure under normal conditions, but provides automatically against the escape of metal if circumstances should arise to increase its resistance to filling the mould completely, or if the piston should be a tight fit in the pump cylinder.

A loose stem end g17H10, which is hollow, forms the head of the piston, the two parts being separated by a narrow gap when the piston is at the top of its stroke. Hot metal, flowing through this gap and down inside the hollow head, fills the space below. As soon as the piston begins to travel downwards, its main stem closes the gap, and the metal, unable to return to the pot, is driven down, to open and flow past the pump body hat valve b23H6 on its way to the nozzle.

Meanwhile, the piston operating rod 19H has continued to rise, until and after the piston stroke is completed by the mould being unable to contain more metal. As the latter condition brings the lever c18H and eye a20H2 to rest, provision is made to absorb the excess motion of the rod and its upper crosshead a19H3. Integral with this crosshead is a boss, drilled vertically, and with its upper face forming an abutment for the two compression springs b20H and 20H11. The upper ends of these bear against the knurled nut c20H5 which is screwed on the upper end of the piston spring rod b20H1. As this rod passes down inside the springs and through the drilled boss to terminate in the eye a20H2, it will be seen that any difference in vertical motion between this and the rod 19H is absorbed by the compression of the springs. This compression also maintains pressure on the type-metal during its solidification.

After the mould has been filled, the briefest possible pause is made to allow the metal to solidify – the running speed of the machine is governed by this period which varies with the amount of metal injected, itself dependent upon the size of type being cast. This is the reason why large type must be cast more slowly than the smaller sizes.

The completion of the pump's working cycle consists of all components returning to their rest position in the reverse order of the operations described above. Note that the withdrawal of the piston would tend to empty not only the nozzle but the passage leading to it; this is checked by the pump body hat valve being quickly drawn up to its seating, thereby cutting off the return flow and ensuring that a full charge of metal shall pass into the piston head in readiness for the next injection.

When all parts are at rest, the compression spring a32H4 (*see fig. 2*) housed inside the link a32H, by pressing the plunger a32H3 upwards, holds the piston at the top of its stroke until it is actuated in the following cycle.

Cleaning and Lubrication

Oil should be applied at the oil-holes which are clearly seen in and adjoining the pump lever assembly, and at the crossheads where relative movement of sliding parts occurs.

As the temperature of the pump body lifting lever d25H, under working conditions, is too high for oil to be effective at its bearings, these are fitted with self-lubricating carbon rings which require no regular attention. If the pump body lifting lever b26H fails to move freely, tap out the stud a26H1 on which it pivots, after unscrewing the stud retaining nut; this is best done when the type metal is solid, providing a rigid support for the lever. Clean the stud and smear it with piston paste before replacing.

The piston lever bearings c18H1, which also are very hot, should be brushed vigorously with a wire brush

weekly to remove dross or other impurities, cleaned with cotton waste, and lubricated with a little pump piston paste applied with the brush.

Accumulations of dross inside the nozzle, pump body, piston, valve and the channel to the nozzle are a menace to good type production and these parts must be kept thoroughly clean.

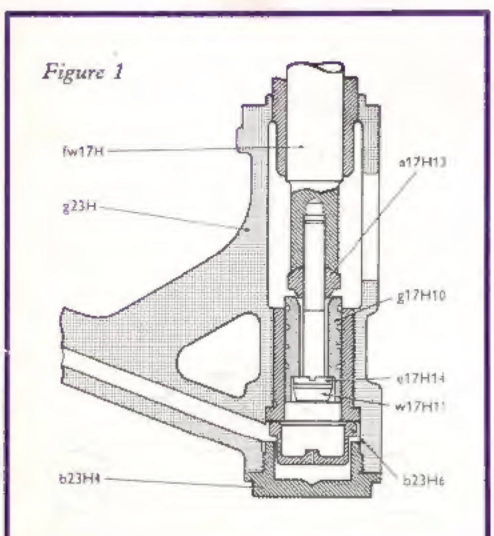
Every week, while the pump assembly is still in the pot, and the metal is molten, first unscrew the nozzle and thoroughly clean the threads and burnish them with piston paste. Then withdraw the piston, using the extractor tool X31CT, or a convenient lever, if necessary (but on no account tap the piston shoulder) to free this component. Before it has time to cool, slacken the lock nut a17H13 of the end screw w17H11 and dismantle the end. With a wire brush, remove the dross from all parts including the metal-inlet grooves, but on no account use a file or emery cloth. Lay the piston on a clean surface.

Take out the pump body and immediately unscrew the plug from the base, releasing the hat valve; fracture may result if this action is delayed sufficiently for the type metal to solidify.

All the parts should now be freed from dross by means of a wire brush, use of the appropriate cleaning tool or by insertion of the right-sized drill (see instructions detailed on the Machine Label). A small quantity of piston paste on the brush will be found helpful. The interior of the pump bushings, both upper and lower, must be vigorously brushed clean and, finally, all interior surfaces must be cleaned with rag or cotton waste to remove loosened dross. For further details, see next sub-head, "Drilling".

The recess in the nozzle-end bearing 23H1 of the pump must be kept clear to allow the pin a26H3 to float; tool 4CT4 is available for this duty. When they are thoroughly clean, apply a small quantity of piston paste to all the bearing surfaces and threads of both pump body and piston before re-assembly; this is their sole lubrication, as no oil or grease could withstand the normal working temperature. The correct adjustment for the head gives it $\frac{1}{32}$" end-play, obtained by fully tightening the end screw and then slackening it off one half turn. Before finally locking the locknut, re-immerse the piston in hot metal to bring it up to normal working temperature and treat the pump body similarly before securing the plug.

Daily attention to the pump need be no more than removing the piston, applying the wire brush, for polishing, with a slight smear of the paste, but this is a duty that must not be omitted. In some establishments, it is customary to have a spare pump so that the cleaning can be done without delaying production.



Details of the piston-end assembly are clearly seen in this sectional view of the pump body.

fw17H Piston
g17H10 Piston Stem End
w17H11 Piston Stem End Screw
a17H13 Lock Nut
e17H14 Washer
g23H Pump Body
b23H4 Pump Body Plug, bottom
b23H6 Hat Valve

Drilling

Remember that a tool – whether drill, tap, die or screwdriver – is liable to have its temper destroyed if it is unduly heated by contact with molten metal or hot components; a cutting tool in such a condition is practically worthless.

Nevertheless, nozzle-obstructions do sometimes occur during working, and for their rapid clearance, it is advisable to keep a special $\frac{1}{16}$" drill for restoring the aperture of a hot nozzle, an operation that can be quickly completed without removing it from the machine. It should be done immediately there is any apparent need for it, as a fouled nozzle is one of the principal causes of imperfect type.

Every week, drill the inclined channel from the base of the pump to the nozzle socket with the special tool (4CT1) supplied for the purpose. Note that this has a flat blade and it is not sufficient merely to push it up till the tip is visible below the nozzle seating – it must be continually rotated as it travels, with a proper drilling action to ensure a full-bore passage.

The hole in the hat valve must also be kept clear, but on no account increase its ·059" diameter. If a drill of correct size is not available, do not apply a larger one, but probe the hole with a piece of wire or other small improvised tool.

A daily necessity is the drilling of the nozzle, which must be carried out as an invariable routine. When it has been heated to working temperature, unscrew the nozzle and allow it to cool. Then, from the base, drill upwards for a distance of not more than $2\frac{3}{16}$", that is to say, to the point where the hole tapers inwards. For a composition nozzle No. 16, use a $\frac{3}{32}$" drill (a4CT2). From the top, drill down with a $\frac{1}{16}$" drill (4CT3), but be careful that the drill is kept vertical and that the chuck does not touch the edge of the hole. If necessary, the thread in the nozzle socket can be cleaned, when cold, with a $\frac{1}{2}$" tap (4CT5) having 13 threads per inch; remove any deposit of piston paste or dross from the recess above the threads; the vertical passage below, leading to the inclined channel, is cleared by means of the special tool (4CT7). Before replacing the nozzle, make sure that its thread and the seating faces are absolutely clean, or leakage will occur.

Every night, or whenever the metal is to be allowed to cool down, remove the nozzle, as the tin/antimony ingredients of the alloy form a compound which separates out and rises. Without this precaution, a plug of the compound may form in the nozzle; this can be difficult to clear. Provided that a spare nozzle can be substituted, the cleaning may be carried out while the machine is in operation.

Adjusting Piston Stem End

As already mentioned under "Cleaning and Lubrication", the loose end of the piston g17H10 must have $\frac{1}{32}$" movement, which is the equivalent of half a turn of the end screw w17H11, locked by the nut a17H13. Immerse the piston in hot metal before finally tightening this.

Squaring Nozzle to Machine

To create a metal-tight joint and to prevent severe wear of the nozzle, the movement of the latter up into the conical opening in the base of the mould must be strictly vertical; so also must be the angle of the axis of the nozzle.

In order to make any necessary adjustment, remove from the caster the matrix-case, bridge, mould and especially the pump piston as a safety precaution. When making any adjustment to the pump mechanism, it is advisable first to remove the pump and piston levers c24H and c18H by extracting their pins, 20H3 and 31H5, and lifting off. Using the three screws from the mould, secure in its place the nozzle gauge (8CT3). Next raise the melting pot to the casting position, release the hand-operated pump trip and turn the machine to 220° – i.e. beginning of the pumping action. Into the gap between the end of the pump body lifting lever b26H and the swing frame (b37H), insert a convenient

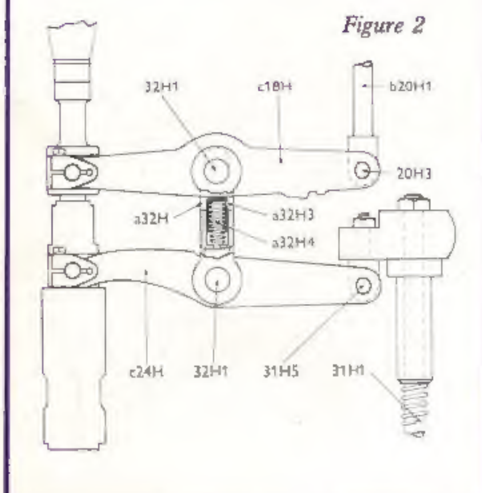


Figure 2

wooden wedge, or type metal of equal thickness. Now lower the melting pot and remove both the nozzle gauge and the nozzle. Making sure that the machine is still at 220°, and the packing intact under the lifting lever, raise the melting pot to the casting position.

In place of the nozzle, screw in the nozzle squaring post (8CT6), taking care that its shoulder is flush down on the pump body. With a set-square resting accurately on a plate laid on the top face of the main stand, verify that the post is standing strictly perpendicular when seen from the front.

To adjust, slacken the lock nut 28H5 (lower) and move the nut 28H4 (middle) (above the pump body lifting lever d25H) up or down as required. Note that as there are three adjusting nuts symbolled 28H4 and two lock nuts 28H5, it is very important not to work on the wrong one. After tightening the lock-nut, check again to ensure that the correct setting has not been lost.

The post will stand square front and rear unless the pump body or the rear lifting lever is badly worn, in which case the affected part must be renewed.

After removing the nozzle squaring post and the packing under the lifting lever, proceed to centralize the nozzle.

To avoid any lateral strain when the nozzle is seated in the mould, there must be clearance all round between the lifting pin and its recessed bearing.

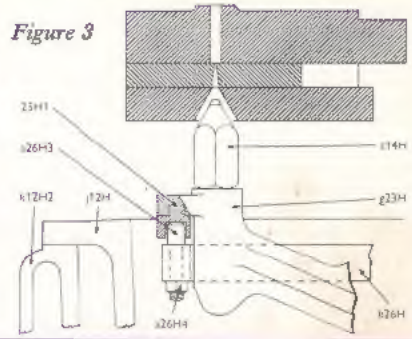
j12H Melting Pot
k12H2 Melting Pot Casing
c14H Nozzle
g23H Pump Body
23H1 Pump Body Bearing (Nozzle End)
b26H Pump Body Lifting Lever (Nozzle End)
a26H3 Pin for Lever b26H
a26H4 Nut for Pin a26H3

Details of the spring link connecting the centres of the piston lever and the lever raising the upper end of the pump body.

c18H Piston Lever
b20H1 Piston Spring Rod
20H3 Rod Eye Pin
c24H Pump Body Lever
31H1 Pump Body Spring Rod
31H5 Rod Eye Pin
a32H Pump Lever Connecting Link
32H1 Pump Lever Connecting Link Pin
a32H3 Pump Lever Connecting Link Plunger
a32H4 Pump Lever Connecting Link Plunger Spring

k12H2 Melting Pot Casing
a12H10 Casing Stud Nut
a37H9 Swing Frame Adjusting Screw, long
a37H10 Swing Frame Adjusting Screw, short
a37H12 Swing Frame Table

Figure 3



Centralizing Nozzle to Seating in Mould

While the conical seatings will ensure that the nozzle is brought to its correct position before pumping begins, strain and wear will result if the nozzle has to be pressed to one side in order to reach it. The condition is satisfactory when the pump body lifting lever pin a26H3 is central (or approximately central) in the recessed pump body bearing 23H1; the adjustment is made in a horizontal plane only.

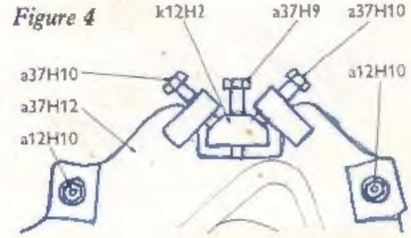
With the mould and piston removed from the machine and the nozzle replaced, secure the nozzle gauge in position. Raise the pot to casting position, release the pump hand trip and turn the machine to 220°, thereby lifting the nozzle to pumping position. It should now have risen straight into the centre of the seating in the nozzle gauge. To verify, insert sufficient packing under the end of the pump body lifting lever b26H to drop the nozzle about $\frac{1}{16}$" from the seating; it should still be located centrally and, if moved by hand, there should be slight travel in any direction, showing that there is all-round clearance between the sides of the pump body lifting lever pin a26H3 and its bearing 23H1.

If this is not the case, loosen the two melting pot stud nuts a12H10 holding the melting pot casing k12H2 to the swing frame table a37H12; these studs have sufficient side-clearance in their holes to allow 2-dimensional adjustment. It is not necessary to release the melting pot casing screw (12H8) at the other end of the pot casing, as this has vertical as well as lateral clearance.

Bring the nozzle into its correct position by means of the three adjusting screws a37H9 and 10. These determine the relative locations of the swing frame table (which, when in the casting position, has a fixed posi-

Inverted plan view showing the positions of the studs and nuts governing the location of the melting pot relatively to the swing frame table. This location can be varied to centralize the nozzle in its seating in the mould.

Figure 4



tion in relation to the nozzle gauge) and the melting pot casing which, by way of the lifting lever bearings and lever, also governs the position of the pump and thus of the nozzle. Note that both the side screws a37H10 impinge on a projection of the pot casing and affect its lateral setting, while the central screw a37H9, which impinges on the table, affects the endwise setting of the pot casing. Before the central screw is tightened, the other two must be slackened off, or vice versa.

When the nozzle is properly located, check that there is clearance between the yokes of the lifting levers d25H and b26H and the operating rod a28H, if necessary moving the rear of the metal pot laterally to obtain this. Then retighten the two nuts a12H10 to hold the setting. Finally, take off the nozzle gauge and replace the mould and the piston.

Adjusting Pump Body Lift

(For machines prior to No. 22,000 and not converted.)

The correctness of this motion is dependent, in the first place, on the accurate setting of the connecting rods (68E and 22H) of the pump cam lever and pump bell crank and of the trip tube collar (b49D1), which should be verified before disturbing any other adjustment. As the normal lift is derived from the pump body spring a31H and from the pump body lifting spring a27H, but not from the piston spring b20H (which is designed to be effective during pumping only), the following conditions, at a machine setting of 220°, indicate that pump adjustments are correct: (1) Nut 31H13 is in contact with the base of the swing frame post (i.e. spring a31H is operative). (2) Operating rod lever 29H is about $\frac{1}{32}$" clear below the machined recess in the piston lever c18H (i.e. spring a27H is operative). (3) Connecting pin 32H1 is free in the piston lever (i.e. springs b20H and 20H11 are inoperative).

If these conditions are not fulfilled, bring the operating rod lever 29H to its correct position by adjustment of nut 28H4 (top). We repeat – as there are three adjusting nuts symbolled 28H4 and two lock nuts 28H5 on this rod, it is very important not to work on the wrong one.

Slacken off the lock nut and adjusting nut 31H13 till they are well clear of the casting, adjust the crosshead stop 31H8 to free the connecting pin 32H1 where it passes through the piston lever, tighten the adjusting nut 31H13 till it contacts with the casting again and then secure it with its lock nut.

Finally, check the work, turning the machine by hand.

Adjusting Pump Body Lift

(For machines No. 22,000 and over, and earlier models converted.)

The correctness of this motion is dependent, in the first place, on the accurate setting of the pump cam lever connecting rod (68E) and of the trip tube collar (b49D1), which should be verified before disturbing any other adjustment. The normal lift is derived from the piston spring b20H (Machines No. 22,701 and over are fitted with duplex springs Xb20H) which is designed to be effective during pumping only. As the hole in the centre of the piston lever (through which the connecting link pin 32H1 passes) is no longer circular but elongated vertically, and any internal clearance is difficult to measure, the correct position of the pin can only be assured by carrying out the full detail of making the adjustment.

It is first necessary to provide a clearance of $\frac{1}{16}$" between the collar stop 31H16 and the swing frame post d38H when the machine is at 80° (i.e. pump released). Having turned to this angle with the hand pump trip disengaged, obtain the required clearance by adjusting the bell crank connecting rod 22H – remember that lock nut 22H4 has a left-hand thread, and that this instruction takes precedence over the 10¾" dimension mentioned in "Adjusting Bell Crank Connecting Rod". Retighten the lock nuts, turn the machine one revolution and check that the adjustment holds.

Bring the operating rod lever to its correct position by adjustment of nut 28H4 (top). We repeat – as there are three adjusting nuts symbolled 28H4 and two lock-nuts 28H5 on this rod, it is very important not to work on the wrong one. With the machine at 220°, there should be about $\frac{1}{32}$" clearance between this lever and the machined recess in the lower edge of the piston lever c18H. Retighten the upper lock nut 28H5, turn the machine and check the clearance.

To obtain the correct setting of the piston spring or springs, first slacken the nut 31H13 to clear the casting d38H. Turn the machine to 220°, release the crosshead stop nut 31H9 and turn the crosshead stop 31H8 clockwise until the pin 32H1 of the pump lever connecting link is quite free. Now turn the crosshead stop anti-clockwise until the link pin just touches the piston lever; then reverse the motion, going back half a turn clockwise, in which position the crosshead stop must be locked with the nut 31H9. Next, turn the machine to 80° and, if necessary, correct the adjustment of the bell crank connecting rod to give the $\frac{1}{16}$" clearance above the collar stop 31H16 as already instructed. Turn the machine through one revolution and check the adjustment. With the machine at 220°, finally bring the nut 31H13 up to the casting and lock it in that position.

Adjusting Piston Spring

The compression of the piston spring, whether single 20H or duplex Xb20H, must be adjusted to force hot metal into the mould with sufficient pressure to ensure perfect casting. Affecting the requirements are many variables, including size of type, condition of pump body, condition of piston, quality of metal and efficiency of the heating equipment; consequently it is only possible to give the Operative very general guidance – his own experience will be more valuable.

On a machine in perfect condition, working on composition with a single piston spring, the nut c20H5 may be ½" below the top of the pump spring rod b20H1; in the case of a worn piston, this distance may be extended to an inch or more as the pressure is increased.

With duplex springs, the combined pressure is approximately 75 lb. when the lock nut is level with the top of the rod, and it increases 80 lb. with every inch by which the length is reduced. A shoulder on the rod, for composition, limits the pressure to approximately 160 lb. A special piston rod, graduated in inches, is provided for composition machines having lead and rule and/or display Attachments, and the pressure with this can be raised to 490 lb. When changing to or from composition work, do not forget to adjust the spring accordingly.

Note that, as duplex springs are designed for use with moulds having solid gib plate adjustment of the crossblock, the piston spring pressure must be reduced if a mould with spring-supported gib plate is used.